Co-funded by the Erasmus+ Programme of the European Union

Climate Change Induced Disaster Management in Africa

Course Syllabus

Course title

Public Participatory GIS and Spatial Data Infrastructure in Disaster Management

Course ECTS credits: 10

Course hour distribution by methods of studies

Lectures	Exercises	Self-study	Seminar	Final project	Total
25	60	105	10	50	250

Annotation of the course

The course will introduce Volunteering Information Systems and Spatial Data Infrastructures through the implementation of theoretical and practical classes. Desktop and mobile tools applications for volunteering web mapping will be exploited in relation to different hazards, such as floods, fire and deforestation. Spatial data infrastructure services will be presented, along with practical implementations of remotely sensed data for crisis mapping.

Aim of the course

The students will acquire knowledge and skills on how disaster maps are produced through state-of-the-art GIS and remote sensing techniques, along with the emerging contribution of public participatory for the data collection process, in the form of remote or in-situ collaborative mapping. Complementary to the theoretical aspects, practical experience with the data provided by services devoted to climate change induced disaster monitoring and management will be shown and discussed. The course will develop advanced skills in the field of GIS, geospatial data management and mapping with the aim of tailoring such activities and their final products for the specific needs of stakeholders intervening in case of a disaster mitigation, resilience and emergency management.

Learning outcomes

On completion of the course, the student should be able to:

Knowledge and understanding

- Comprehend the fundamentals of Geographical and Volunteering Information Systems, Remote Sensing and geospatial data management for exploiting, managing and processing datasets for disaster mitigation and crisis mapping.
- To understand the added value of crowd-sourced spatial data through web mapping tools with relation to disaster mapping and be able to initiate/participate in collaborative mapping events.
- Comprehend in-depth knowledge of open GIS and VGI platforms and web-based services for disaster related topics such as flood, fire, deforestation and drought hazards.
- Knowledge on spatial data infrastructures in relation to data gathering, accessing and using with particular focus on the Copernicus programme.

Skills and abilities

- Use open source GIS software, desktop and mobile mapping techniques, cloud-based dissemination and processing services, and ability to use them, possibly, in decision support systems for hazard and risk management.
- Explore geospatial data and create disaster related maps.
- Operate with free and open satellite data with respect to a variety of hazards.

Critical judgement and evaluation

- Analysis and understanding of the goals, assumptions, and requirements associated with geospatial data for climate change disaster management.
- Understanding geographic data quality and their fit for use with respect to different applications.
- Determining the appropriate tools and datasets with respect to different problems.

Methods of course studies (*Educational approach*)

Integrated approach (theory and practice): theory in parallel with applications and examples
Project-based learning

Methods for the assessment of student achievements (*the formula and the definition of the cumulative score)*

PM=70% (Theory + Practice) + 30% Project

30% of the exam- Project results have to be evaluated – 20% the work and 10% the report.

70 % of the exam - Theory and the practice subdivided into 10 topics. 10 questions + practice deliverables.

Study subject modules to be completed before this Course studies (*Prerequisites*)

Basic knowledge of mathematics, statistics, geography, physical processing, environmental protection.
Basic skills of Information Technologies.

Tentative Schedule (lectures)

Date	Topic	Objectives
Week 1	1. Basic data structures for both vector and raster (POLIMI) 2. Basic projections and coordinate systems (POLIMI) 3. Attribute handling and spatial operations (SQLs, buffers, spatial searches, overlays) (LU) 4. Basic Cartographic principles (POLIMI) 5. Basic electromagnetic radiation theories (LU) 6. RS resolutions (Spatial, Temporal, Radiometric, Spectral) (IST) 7. Different RS Sensors (IST) 8. Passive RS data formats, geo-referencing, metadata and resampling (LU) 9. Introduction to LiDAR and SAR (Active Sensors), plus Thermal RS (KTH) 10. Image pre-processing, enhancement and transformations (KTH) 11. Image classification (KTH)	Introduction to GIS and Remote Sensing
Week 2	12. Course Introduction 13. Volunteered Geographical Information (VGI) and Climate Change 14. OpenStreetMap (OSM) and OSM Editors; Mapillary 15. Mobile applications for VGIS	To introduce the fundamentals of crowdsourcing data collection, climate change. To introduce open mapping service and its capabilities of providing a big variety of geodata suitable for many applications.

Week 3	16. How to organize a mapping party 17. How to organize a mapathon 18. Using OSM Data	To show the practical aspects of mapping events, their aims and how to achieve them. To introduce mobile applications useful in mapping events and to show the exploitation of the crowd-sourced geodata.
Week 4		
Week 5	19. Spatial Data Infrastructures 20. Copernicus Climate Change 21. Copernicus Emergency Management Service (EMS) platforms 22. Copernicus EMS Rapid Mapping Service 23. Fire Mapping 24. Copernicus European Forest Fire Information System (EFFIS) and Global Wildfire Information System (GWIS)	To introduce the key concepts of remote sensing, data acquisition instruments, data processing and applications; spatial data infrastructure. To get familiar with the Copernicus program, product and services in relation to climate change and disaster management. To provide a theoretical background for fire mapping by the means of satellite data and web services.
Week 6	25. Copernicus Global Land Service 26. Flood Mapping and Copernicus European Flood Awareness (EFAS) and Global Flood Awareness System (GloFAS) 27. Copernicus European Drought Observatory (EDO) and Drought Observatory (GDO) 28. Deforestation 29. European Space Agency's (ESA) Exploitation Platforms	To provide the theoretical background for flood, deforestation mapping by the means of satellite data and Web services. To introduce web-based geospatial data management, data exploitation and processing services.
Week 7		

Tentative Schedule (Exercises, Lab work/Self-studies)

Date	topic	Type*/objective
Week 1	1. QGIS Practicals on lecture topics 1-4 2. SNAP Practicals on lecture topic 6 3. QGIS Practicals on lecture topics 7 and 8 4. SNAP Practicals on lecture topic 9 5. GEE Practicals on lecture topics 10 and 11	Introduction to GIS and Remote Sensing
Week 2	6. Qfield 7. Epicollect/LandslideSurvey 8. Geopaparazzi	Exercises for (1) processing geospatial data in an open-source GIS system, (2) collecting thematic geoinformation through VGI mobile applications, (3 and 4) presenting available apps for collecting VGI.
Week 3	9. OSM Mapping Utilities and Mapathon 10. Mapillary 11. Using OSM Data	Exercises and mapping events for collecting data through classical means like ‘field paper’, desktop applications (OSM editors) and mobile apps (Vespucci/Go Map!!).

Week 4		
Week 5	12. Copernicus Climate Change 13. Copernicus EMS Data Download and Processing 14. Copernicus EFFIS and GWIS: Data Download and Processing	Exercises for processing remotely sensed imagery in open-source GIS. Practical activities for exploiting, downloading and processing satellite imagery for hazard mapping through web-based dissemination and mapping services.
Week 6	15. Copernicus EFAS and GLOFAS: Data Download and Processing 16. Water Quality Monitoring 17. Geonode 18. Deforestation 19. Google Earth Engine (GEE) and JavaScript Introduction - flood/deforestation/air quality mapping 20. Crisis Mapping	Exercises for exploiting, downloading and processing satellite imagery for hazard mapping through web-based dissemination and mapping services. Hands-on sessions for web data management systems, introduction to programming language needed for web-based processing service. Exercises for hazard mapping, giving the possibility to the students to apply the theoretical and practical knowledge obtained through the course.
Week 7		

* e.g. answering questions, collecting data, performing analysis, writing codes, etc.

Tentative Schedule (Seminar, Project)

Date	topic	Type*/objective
Week 1		
Week 2	1. Mobile Applications for VGI	Seminar - To introduce desktop and mobile applications for voluntary mapping contribution.
Week 3	2. Mapillary	Seminar - To introduce the service for crowdsourced imagery collection and how to be used
Week 4	3. Mapping 4. Mapathon	Projects
Week 5	5. Introduction to INSPIRE	Seminar - To introduce the Spatial Data Infrastructure and INSPIRE
Week 6	6.European Space Agency's (ESA) Exploitation Platforms; Data and Information Access Services (DIAS)	Seminar - Introduction to ESAs TEP services (Hydrology, Geohazard, Forest, Urban and Food), as well as the five DIAS services
Week 7	7. Project of disaster mapping and Data Sharing 8. Google Earth Engine Project	Projects

Main bibliography (no more than 3 sources)

No.	Publication authors, year of issue, name, place of issue, publisher, (address of electronic publications and website)
1	FOODY, Giles, et al., editors. *Mapping and the Citizen Sensor*. *Ubiquity Press. JSTOR*, www.jstor.org/stable/j.ctv3t5qzc , 2017
2	NEDOVIC-BUDIC, Z., et al. *Spatial Data Infrastructures SDI in context: north and south*. Boca Raton: CRC Press., 2011
3	*QGIS training handbook*, https://docs.qgis.org/3.10/en/docs/training_manual/, Accessed 21 Apr. 2020.

Additional bibliography (no more than 10 sources)

No.	Publication authors, name, place of issue, publisher, year of issue (address of electronic publications and website)
1	LONGLEY, Paul A., et al. *Geographic information systems and science*. John Wiley & Sons, 2005.
2	CAPINERI, Cristina, et al., editors. *European Handbook of Crowdsourced Geographic Information*. Ubiquity Press. *JSTOR*, www.jstor.org/stable/j.ctv3t5r09, Accessed 21 Apr. 2020, 2016.
3	BARRERA-ESCODA, Antoni, et al. *Projections of temperature and precipitation extremes in the North Western Mediterranean Basin by dynamical downscaling of climate scenarios at high resolution (1971–2050)*. Climatic change, 2014, 122.4: 567-582.
4	DUCHON, Claude; HALE, Robert. *Time series analysis in meteorology and climatology: an introduction*. John Wiley & Sons, 2012.
5	GIRVETZ, Evan H., et al. *Applied climate-change analysis: the climate wizard tool*. PLoS One, 2009, 4.12.
6	YODMANI, Suvit. *Disaster risk management and vulnerability reduction: Protecting the poor*. The Center, 2001.
7	*QField User Guide*, https://qfield.org/docs/user-guide/index.html , Accessed 21 Apr. 2020.
8	*Geopaparazzi Reference Manual*, https://www.geopaparazzi.org/v600/index.html, Accessed 21 Apr. 2020.
9	*Get started with Mapillary,* https://help.mapillary.com/hc/en-us/articles/115001881105-Introduction-to-Mapillary, Accessed 21 Apr. 2020.
10	*Google Earth Engine Developer's Guide*, https://developers.google.com/earth-engine, Accessed 21 Apr. 2020.

Required IT Resources

No.	*Name of the software, manufacturer*	*License type*
1	Internet browser (Firefox/Chrome)	Open source
2	QGIS	Open source
3	QField	Open source
4	Epicollect	Open source
5	Geopaparazzi	Open source
6	Mapillary	Open source
7	LandslideSurvey	Open source

8	Vespucci	Open source

Course completed by

(Signatures)

(Signatures)

Project Coordinator

(Signature)

Confirmation

The module certified by	Faculty of ….., University of ….		
Chairman of the studies committee (full name, signature)		**Date**	